MISR Highlights from the First 18 Months in Earth Orbit

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ABSTRACT

INTRODUCTION

The Multi-angle Imaging SpectroRadiometer (MISR) instrument was launched into polar orbit aboard the Terra spacecraft in December 1999 and collection of Earth imagery began in February 2000. MISR contains nine cameras pointed at fixed along-track directions, and acquires images with view angles at the Earth's surface ranging from 70.5° forward of nadir to 70.5° aftward, in four spectral bands. Spatial sampling ranging from 275 m to 1.1 km is obtained over a 400-km swath width. MISR provides a unique approach to characterizing atmospheric aerosols, the surface, and clouds. Remote sensing capabilities include retrieval of aerosol properties over a wide range of surface types; stereoscopic retrieval of cloud-top heights and cloud-tracked winds, and detection of clouds over snow; and determination of surface spectral albedo and characterization of surface architecture through the use of angular signature information. This paper provides examples of MISR products and highlights results derived from imagery acquired during approximately the first 18 months of the Terra mission.

APPROACH

MISR uses nine separate charge coupled device (CCD)-based pushbroom cameras to observe the Earth at nine discrete angles: one at nadir, plus eight other symmetrically placed cameras that provide fore-aft observations with view angles, at the Earth's surface, of 26.1, 45.6, 60.0, and 70.5° relative to the local vertical. Imagery in four spectral bands (blue, green, red, and near infrared) is provided at each angle, yielding a total of 36 image channels (9 angles x 4 bands).

The retrieval of aerosol optical depth over land from space is a difficult challenge owing to the variable brightness of the land surface. However, multi-angle imagery provides the opportunity to use the enhanced slant paths and variation in signal with angle in conjunction with novel algorithms to detect and characterize atmospheric hazes, over both land and ocean. The results of the aerosol retrieval are also used as input into determination of surface parameters. Among these are directional hemispherical reflectance (albedo); bidirectional reflectance factor (BRF); and parameters describing the angular shape of the BRF, which in turn, provide information about land surface architecture. In addition to utilizing the radiometric variation of MISR imagery with angle, stereophotogrammetric methods using a combination of area and feature matching algorithms are applied to measure the geometric parallax due to cloud height, plus actual motion driven by wind. Examples highlighting these capabilities will be discussed.